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This application guides is intended to help activity personnel retrofit fluorescent lighting. With this guide, an energy manager can determine if replacing T-12 lamp and magnetic ballast fixtures is cost effective.

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NAVAL FACILITIES ENGINEERING SERVICE CENTER PORT HUENEME, CA 93043-4328

Application Guidance for Fluorescent Lighting Projects

This application guide is intended to help activity personnel retrofit fluorescent lighting. With this guide, an energy manager can determine if replacing T-12 lamp and magnetic ballast fixtures is cost effective. Also included are assumptions to make for ECIP/ ECAP (Energy Conservation Investment Program/ Electrical Circuit Analysis Program) life cycle cost calculations.

TECHNICAL BACKGROUND

Although the standard 48-inch, 40-watt T-12 lamp is the most commonly used fluorescent fixture, it is not the most efficient fluorescent light source. Since it will no longer be manufactured after October 1995, as a result of the National Energy Policy Act of 1992, now is the time to consider alternatives. The T-8 lamp with an electronic ballast is the most common retrofit. Table 1 compares T-12 systems to T-8 systems.

The T-8 fixture is generally more efficient. However, there is a 250-lumen (a lumen is a measure of light output, a footcandle is one lumen per square foot) light output difference between the two options. This is about an 8-percent difference. These values assume that both lamps and ballasts are new. With an

Table 1
Comparison of T-12 to T-8 Lamp Systems

Lamp	Rated Initial Lumens	Ballast	2-Lamp Fixture (watts)	Lumens/Watt
F40 CW	3,150	Standard Magnetic	96	62.3
F40 CW	3,150	Energy Efficient	86	69.9
F40 CW	3,150	Electronic	71	76.3
F032 T8	2,900	High Efficiency Magnetic	72	76.5
F032 T8	2,900	Electronic	52	104

older magnetic ballast changing to a T-8 lamp and an electronic ballast can reduce noise levels and provide better color.

When electronic ballasts first became available, in the early eighties, the technology was not regulated. Several manufacturers were selling ballasts that caused power quality problems in other electrical appliances on the same circuit. Ballasts sold today must meet minimum requirements established by ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) and ANSI (American National Standards Institute).

No ballast can have a total harmonic distortion (THD) level over 20 percent. THD is a measure of distortion in power wave forms. This distortion can disrupt the normal operation of AC appliances. There are many ballasts available now with THD levels below 15 percent.

Using a current specification is the best way of ensuring that the ballast is of the highest quality. The Department of Energy has a current specification for electronic ballasts, as do the engineering field divisions in San Diego and Norfolk. When purchasing electronic ballasts, consult these sources to ensure that minimum requirements are met. Ordering from the Defense Logistics Agency (DLA) catalog is another way of ensuring you have the best equipment. To obtain a catalog, call 800-DLA-BULB. It is important to order only those ballasts that offer a 5-year manufacturer's warranty. This will protect you from inferior products.

A word of caution for those considering electronic ballasts in dimmable fluorescent circuits. Make sure that you order appropriate ballasts when upgrading a fluorescent fixture that is currently on a dimmer. The normal electronic ballast will not operate in such a configuration.

Recently, several manufacturers of specular reflectors have made claims that a retrofit with their product allows for removal of half the lamps in a fixture because of the increased light levels. Unfortunately, most of this increased light output is due to cleaning of the luminaire and the installation of new lamps, and is not a permanent improvement. The reflectivity of the luminaire is increased by 5 to 15 percent, at best, with a reflector retrofit. Often a similar light gain can be realized, at less cost, by delamping, cleaning the lens and existing reflector, and installing new lamps. The Naval Facilities Engineering Service Center does not recommend using reflectors as a lighting retrofit.

RETROFIT ECONOMICS

To determine the cost-effectiveness of a retrofit, you must know six things:

1. Number of fixtures and lamps
2. Operational hours per year
3. Local energy charge in $/kWh
4. Local demand charge in $/kW
5. Existing fixture's electrical load
6. Replacement fixture's electrical load

The following four charts were developed by assuming common values for this data (assumptions are included in the following section).

Chart 1 shows the payback versus energy charge for replacing a 2-lamp T-12 fixture and standard magnetic ballasts with a T-8 fixture with electronic ballasts. If you have 2-lamp fixtures in a space that has about 2,500 operational hours per year, this chart can be used to determine the cost-effectiveness of a retrofit. Any ballasts installed before 1990 are standard magnetic ballasts.

Chart 2 shows the payback versus energy charge for replacing a 4-lamp T-12 fixture and standard magnetic ballasts with a T-8 fixture with electronic ballasts. If you have 4-lamp fixtures in a space that has about 2,500 operational hours per year, this chart can be used to estimate the cost-effectiveness of a retrofit. Standard magnetic ballasts are any ballasts installed before 1990.

Magnetic ballasts installed after 1990 are more energy efficient. Energy legislation made this change mandatory for manufacturers. The load of a T-12 fixture with these energy-efficient ballasts is lower than for standard ballasts and the payback is longer.

Chart 3 shows the simple payback for various kWh charges and demand rates when retrofitting a 2-lamp T-12 and energy-efficient magnetic ballast fixture with a T-8 and electronic ballast fixture.

Chart 4 shows the simple payback for various kWh charges and demand rates when retrofitting a 4-lamp, T-12 and energy-efficient magnetic ballast fixture with a T-8 and electronic ballast fixture.

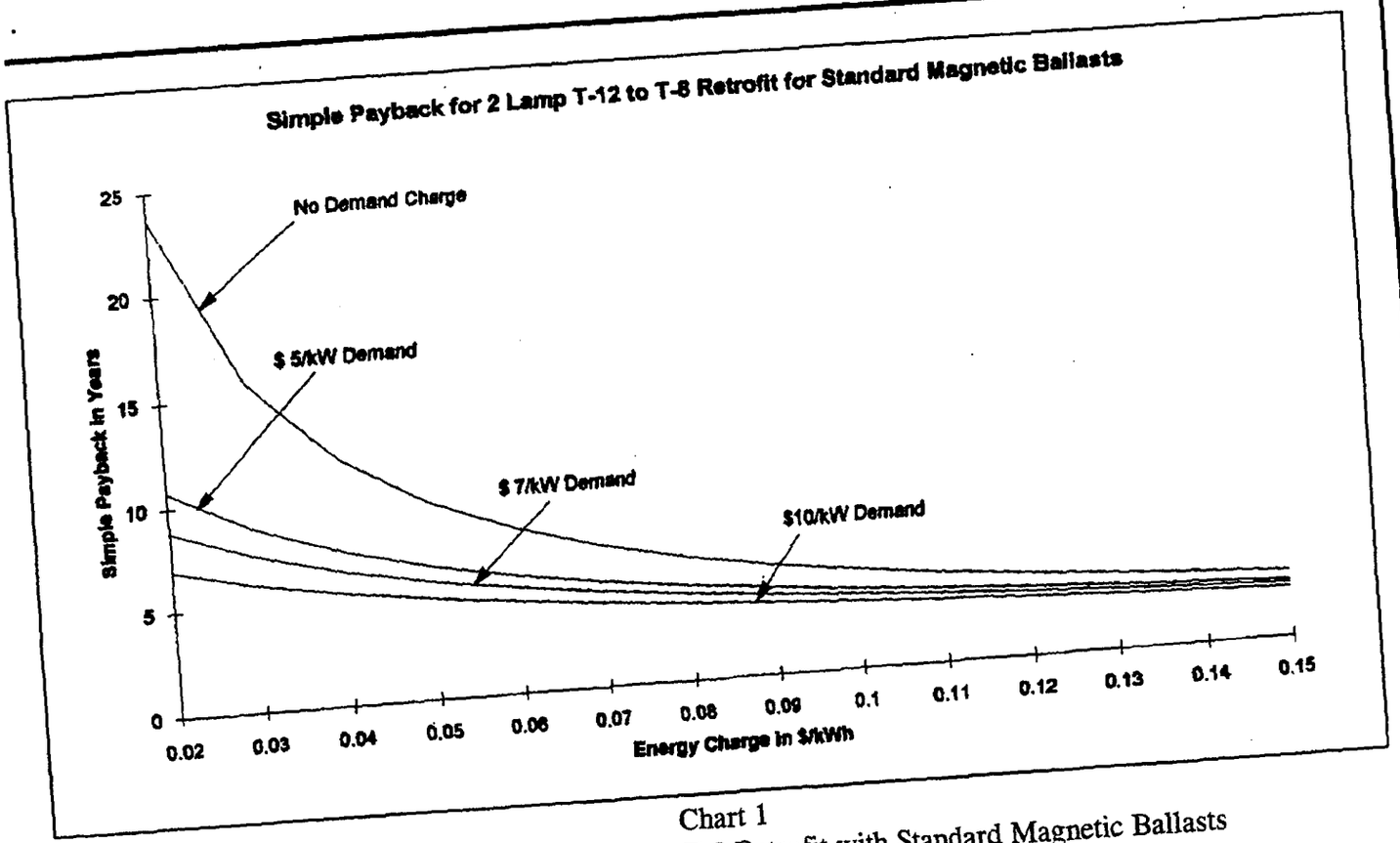

Chart 1

Simple Payback for 2-Lamp T-12 to T-8 Retrofit with Standard Magnetic Ballasts

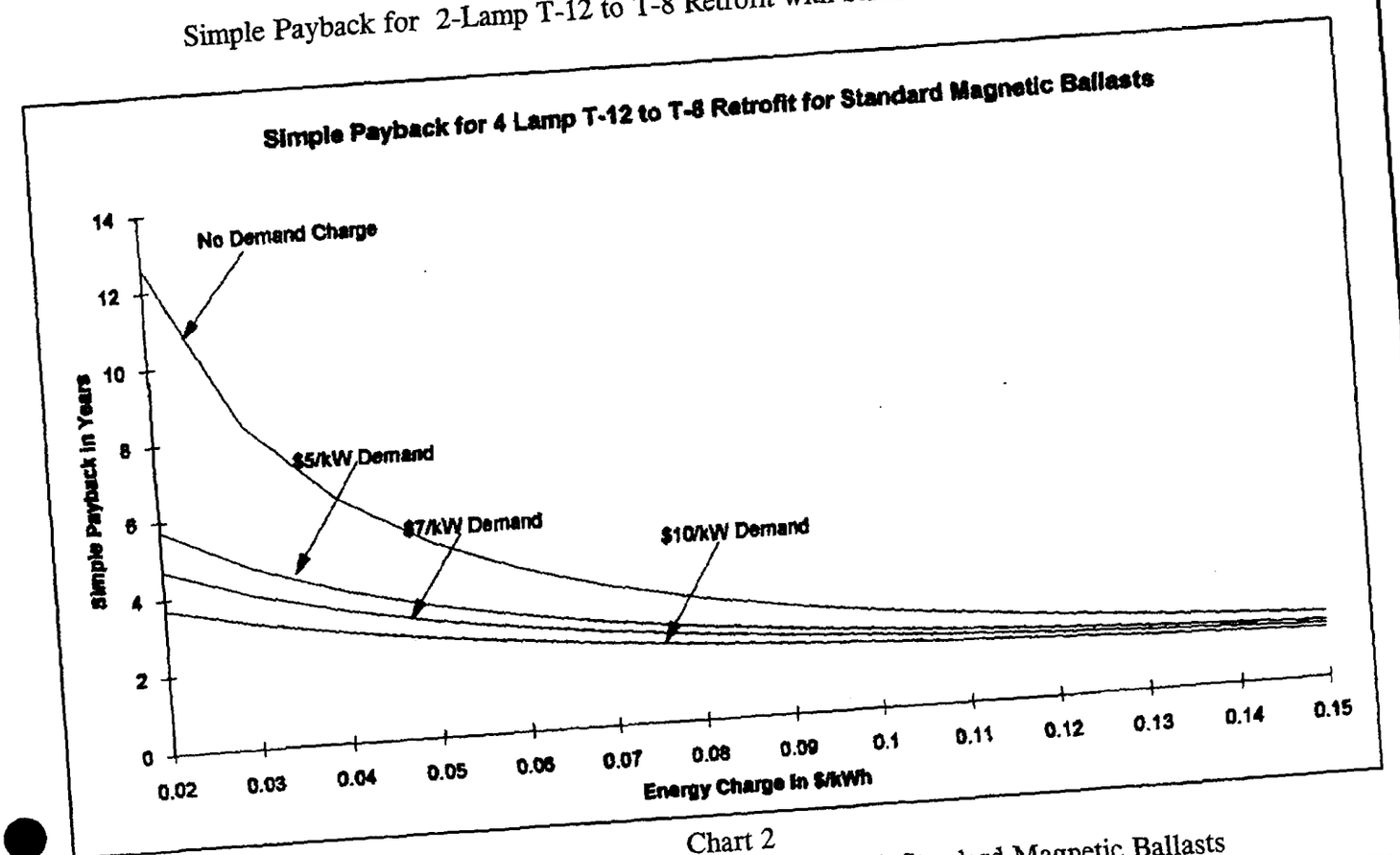

Chart 2

Simple Payback for 4-Lamp T-12 to T-8 Retrofit with Standard Magnetic Ballasts

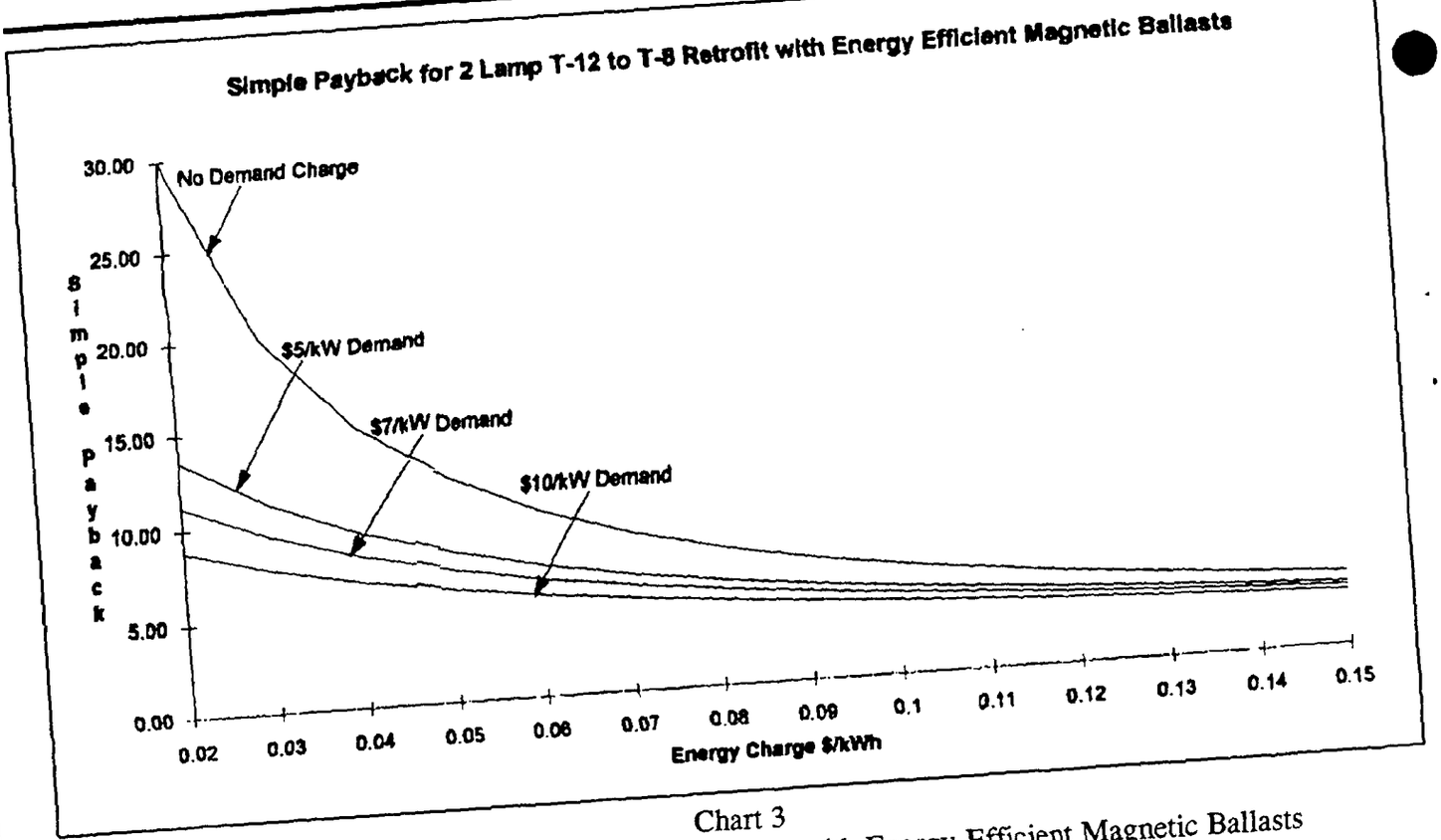

Chart 3

Simple Payback for 2-Lamp T-12 to T-8 Retrofit with Energy-Efficient Magnetic Ballasts

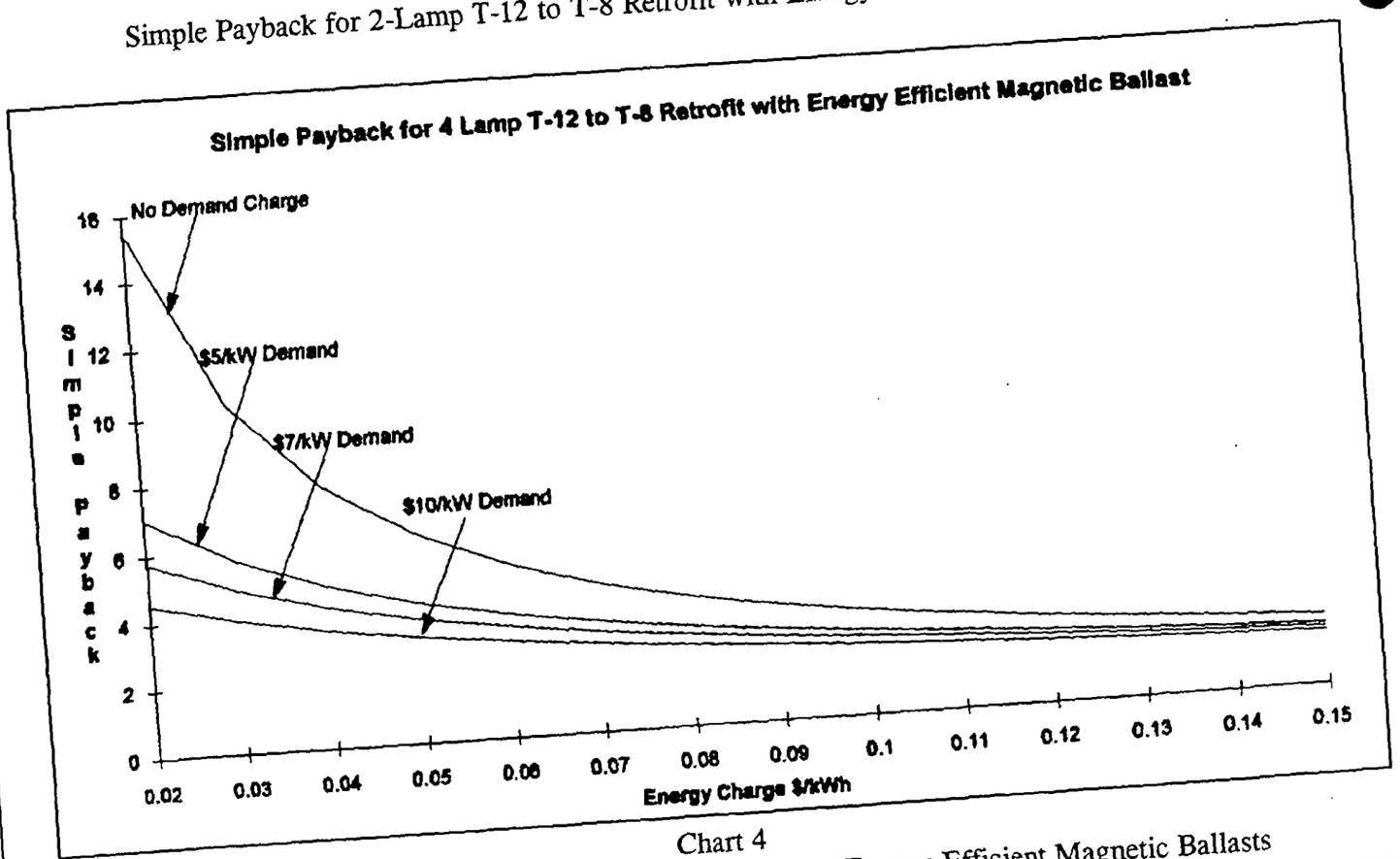

Chart 4

Simple Payback for 4-Lamp T-12 to T-8 Retrofit with Energy-Efficient Magnetic Ballasts

These charts were generated using common values for electrical load and installation and maintenance costs; your particular situation may be different. If your utiltity rates yield a payback less than 10 years on the appropriate chart, then further investigation is warranted.

PROJECT SUBMISSION ASSUMPTIONS

In the interest of standardization, as well as, easing the prioritization for funding process, we offer the following assumptions for lighting retrofit calculations on ECIP/ECAP project submittals.

Existing T-12 Fixture Load

- 2-lamp, 40-watt T-12 fixtures with standard magnetic ballast (pre-1990)

  Fixture load = 95 watts

- 4-lamp, 40-watt T-12 fixtures with standard magnetic ballast (pre-1990)

  Fixture load = 190 watts

- 2-lamp, 40-watt T-12 fixtures with energy-efficient magnetic ballasts (post-1990)

  Fixture load = 88 watts

- 4-lamp, 40-watt T-12 fixtures with energy-efficient magnetic ballasts (post-1990)

  Fixture load = 176 watts

T-8 Fixture and Retrofit Costs

- 2-lamp, 32-watt T-8 with electronic ballasts

Fixture load	= 62 watts
Energy savings per fixture (Std T-12)	= 33 watts
Energy savings per fixture (EEF T-12)	= 26 watts
Retrofit labor cost	= $10.00
Lamp cost	= $ 4.00
Ballast cost	= $25.00

- 4-lamp, 32-watt T-8 with electronic ballasts

Fixture load	= 4 watts
Energy savings per fixture (Std T-12)	= 76 watts
Energy savings per fixture (EEF T-12)	= 62 watts
Retrofit labor cost	= $10.00
Lamp cost	= $ 8.00
Ballast cost	= $30.00

WHAT TO DO NOW

If, after examining the charts, you think you may have a cost-effective project, submit the necessary documentation. If you need help, contact your local EFD for information on ECIP/ECAP documentation. If you have further questions about fluorescent lighting or ballasts, contact:

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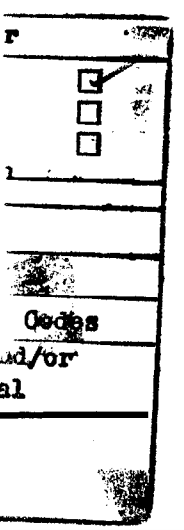

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